

**WHAT IS CLAIMED IS:**

1. A three-dimensional image processing apparatus for creating a shadow image on the outer surface of a 3D model using a shadow model formed by a plurality of polygons, comprising:

shadow model storage means for storing at least coordinates of vertices of the shadow model,

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polygon sorting means for sorting the polygons forming the shadow model into front-facing polygons facing in directions toward a viewpoint of a virtual camera and back-facing polygons facing in directions opposite from the viewpoint of the virtual camera, and

shadow image creating means for creating the shadow image in pixels which are pixels corresponding to the front-facing polygons minus those corresponding to the back-facing polygons.

2. A three-dimensional image processing apparatus according to claim 1, wherein the shadow model storage means stores normal vectors of the respective polygons forming the shadow model, and the polygon sorting means sorts the respective polygon forming the shadow model into the front-facing polygons and the back-facing polygons based on whether an inner product of the normal vector of each polygon and a camera viewing vector representing a viewing direction of the virtual camera is a positive or negative value.

3. A three-dimensional image processing apparatus according to claim 1, further comprising model image creating means for creating an image by applying rendering to a polygon model except the shadow model, and model image storage means for storing the image created by the model image creating means while relating frame color data which are color data of pixels to Z-values which are distances to the polygons corresponding to the respective pixels from the viewpoint of the virtual camera in a simulated three-dimensional space, wherein the shadow creating means changes the frame color data of the pixels stored in the model image storage means for shadow creating pixels which are pixels corresponding to the front-facing polygons of the shadow model whose distances from the viewpoint of the virtual camera in the simulated three-dimensional space are smaller than the Z-values of the corresponding pixels minus pixels corresponding to the back-facing polygons of the shadow model whose distances from the viewpoint of the virtual camera in the simulated three-dimensional space are smaller than the Z-values of the corresponding pixels.

4. A three-dimensional image processing apparatus according to claim 3, wherein the shadow creating means subtracts a predetermined value from the frame color data of the shadow creating pixels which are stored in the model image

storage means.

5. A three-dimensional image processing apparatus according to claim 3, wherein the shadow creating means multiplies the frame color data of the shadow creating pixels which are stored in the model image storage means by a predetermined value.

6. A three-dimensional image processing apparatus according to claim 3, wherein the shadow model storage means stores a single color data of the shadow model and the shadow creating means subtracts the color data of the shadow model from the frame color data of the shadow creating pixels which are stored in the model image storage means.

7. A three-dimensional image processing apparatus according to claim 1, wherein the 3D model is a character movable in a simulated three-dimensional space.

8. A readable storage medium storing a three-dimensional image processing program for creating a shadow image on the outer surface of a 3D model using a shadow model formed by a plurality of polygons, the program comprising the steps of:  
storing at least coordinates of vertices of the shadow model,

sorting the polygons forming the shadow model into front-facing polygons facing in directions toward a viewpoint of a virtual camera and back-facing polygons facing in directions opposite from the viewpoint of the virtual camera, and

creating the shadow images in pixels which are pixels corresponding to the front-facing polygons minus those corresponding to the back-facing polygons.

9. A readable storage medium according to claim 8, wherein normal vectors of the respective polygons forming the shadow model are stored, and the polygon sorting processing is performed to sort the respective polygon forming the shadow model into the front-facing polygons and the back-facing polygons based on whether an inner product of the normal vector of each polygon and a camera viewing vector representing a viewing direction of the virtual camera is a positive or negative value.

10. A readable storage medium according to claim 8, wherein the program further comprises a model image creating processing step for creating an image by applying rendering to a polygon model except the shadow model, and a storing processing step for storing the image created by the model image creating processing while relating frame color data which are color data of pixels to Z-values which are distances to the polygons

corresponding to the respective pixels from the viewpoint of the virtual camera in a simulated three-dimensional space, wherein, during the shadow image creating processing, the frame color data of the pixels stored in the model image storage means are changed for shadow creating pixels which are pixels corresponding to the front-facing polygons of the shadow model whose distances from the viewpoint of the virtual camera in the simulated three-dimensional space are smaller than the Z-values of the corresponding pixels minus pixels corresponding to the back-facing polygons of the shadow model whose distances from the viewpoint of the virtual camera in the simulated three-dimensional space are smaller than the Z-values of the corresponding pixels.

11. A readable storage medium according to claim 10, wherein a predetermined value is subtracted from the frame color data of the shadow creating pixels which are stored in the model image storage means during the shadow image creating processing.

12. A readable storage medium according to claim 10, wherein the frame color data of the shadow creating pixels which are stored in the model image storage means are multiplied by a predetermined value during the shadow image creating processing.

13. A readable storage medium according to claim 10,

wherein a single color data of the shadow model is stored, and the color data of the shadow model is subtracted from the frame color data of the shadow creating pixels which are stored in the model image storage means during the shadow image creating processing.

14. A readable storage medium according to claim 8, wherein the 3D model is a character movable in a simulated three-dimensional space.

15. A three-dimensional image processing method for creating a shadow image on the outer surface of a 3D model using a shadow model formed by a plurality of polygons, the method comprising the steps of:

storing at least coordinates of vertices of the shadow model,

sorting the polygons forming the shadow model into front-facing polygons facing in directions toward a viewpoint of a virtual camera and back-facing polygons facing in directions opposite from the viewpoint of the virtual camera, and

creating the shadow images in pixels which are pixels corresponding to the front-facing polygons minus those corresponding to the back-facing polygons.

16. A video game system, comprising:

a three-dimensional image processing apparatus for creating a shadow image on the outer surface of a 3D model using a shadow model formed by a plurality of polygons, including:

shadow model storage means for storing at least coordinates of vertices of the shadow model,

polygon sorting means for sorting the polygons forming the shadow model into front-facing polygons facing in directions toward a viewpoint of a virtual camera and back-facing polygons facing in directions opposite from the viewpoint of the virtual camera, and

shadow image creating means for creating the shadow image in pixels which are pixels corresponding to the front-facing polygons minus those corresponding to the back-facing polygons.

image display means for displaying an image including a shadow image on the outer surface of a 3D model,

program storage means for storing a game program data, and

externally operable operation means,

wherein the three-dimensional image processing apparatus displays images on the image display means in accordance with the game program data.